JOURNAL OF THE IRON AND STEEL INSTITUTE

Volume 206
July–December 1968

EDITOR
A. Post, T. D.

MANAGING EDITOR
H. F. Cleere, F.S.A.

EXECUTIVE EDITOR
T. L. Hughes

PRODUCTION EDITOR
C. H. Inman

Published at the offices of
THE IRON AND STEEL INSTITUTE
4 Grosvenor Gardens London SW1

THE IRON AND STEEL INSTITUTE 4 Grosvenor Gardens London SW1

COUNCIL AND OFFICERS

(As at 1st January 1969)

Patron H. M. The Queen

President John Hugh Chesters **President Elect** Niall Campbell Macdiarmid

Past Presidents

The Rt. Hon. the Earl of Dudley, M.C.
Sir Andrew McCance, F.R.S.
J. R. Menzies-Wilson, O.B.E.
Capt. H. Leighton Davies, C.B.E.
The Hon. R. G. Lyttelton
Herbert Henry Burton, C.B.E.
Arnold H. Ingen-Housz
Sir Charles R. Wheeler, C.B.E.
William Barr, O.B.E.
William Frederick Cartwright, D.L.
Sir Charles Goodeve, O.B.E., F.R.S.
Sir Maurice Fiennes
Frank Bernard George
Frank H. Saniter, O.B.E.
William Frederick Gilbertson, J.P.
Sir Douglas Bruce-Gardner, Bt.
Norman E. Jones

Honorary Treasurer Lionel Roger Price Pugh, V.R.D., D.L.

Vice-Presidents

Thomas Rae Craig, O.B.E., T.D.
Michael Frederick Dowding
Howard Poulsom Forder
Geoffrey Thomas Harris, C.B.E.
Philip Everitt Holloway
Norman Cecil Lake
Sir Wilton Lee
Niall Campbell Macdiarmid
Arthur George Quarrell

Honorary Vice-Presidents

Alfonso de Churruca
Robert Durrer
Gunnar Schjelderup
Sir Arthur Matthews, O.B.E.
Joseph Oberegger
Berndt Gustaf Grönblom
Evert Wijkander
Eugène Louis Dupuy
Baron Walckenaer
Ian Frederick Lettsom Elliot
Gustavus Henry Latham
Baron van der Rest
William Reid Brown, D.S.O.
Giovanni Falck
John Watson Jenkin
Thomas Jolly
Ernesto Manuelli
James Bliss Austin
Donald Arthur Oliver, C.B.E.
Pieter van Delden
Hermann Schenck
William Charles Bell
Richard Alan Hacking, O.B.E.
Charles Henry Trelease Williams, C.B.E.
Sir Robert Shone, C.B.E.
Pierre Coheur
Dara Phiroz Antia
Bal Raj Nijhawan
Leonard Bessemer Pfeil, O.B.E., F.R.S.
Sir Richard Summers
Sir Charles Sykes, C.B.E., F.R.S.
Alexander Reith Gray
Eric Winearls Colbeck
Christian Martin Krüger
George S. Rose
Edward Thomas Judge
Geoffrey Weston Wells, D.L.
Rhys William Evans, T.D.
Edward Walters Senior, C.M.G.
Marc Allard
Norman Percy Allen, C.B., F.R.S.
Patrick Muirhead Thomas, D.S.O., T.D.
Francis John Somers, T.D.

Members of Council

William Owen Campbell Adamson
Harold Montague Finniston
George Foster
Stephen Alexander Reith Gray
George Edward Desmond Halahan
Norman Hanlon
John Arthur Kilby
Thomas Sheldon Kilpatrick
Henry William Kirkby
Peter Alex Matthews
Jack Nutting
Frederick Denys Richardson, F.R.S.
Ian Stephen Scott-Maxwell, O.B.E.
Ronald Philip Towndrow
Thomas John Williams, O.B.E.

Honorary Members of Council

Tom Dennison
Sydney William Evans
Albert Jackson, O.B.E.
Jan Hendrick von Lindern
James Woodham Menter, F.R.S.
Dennis S. Oliver

Deputy Director, BISRA/IGL . . . . . W. C. F. Hessenberg
President of The Institute of Metals . . . . . I. Jenkins
President of The Institution of Metallurgists . . . . . W. A. Baker
President-Elect of The Institution of Metallurgists . . . . . A. H. Sully, O.B.E.
Chairman of the Engineering Committee . . . . . C. E. H. Morris
Chairman of the Publications Committee . . . . . F. D. Richardson, F.R.S.
Chairman of the Meetings Committee . . . . . R. Mayorcas
President of the Birmingham Metallurgical Association . . . . . D. C. Moore
Chairman of the Bradford Metallurgical Society . . . . . P. Hardaker
Chairman of the Chilterns Metallurgical Society . . . . . C. E. Rhodes
President of the Cleveland Institution of Engineers . . . . . H. M. Ryan
President of the East Midlands Metallurgical Society . . . . . R. Haynes
President of the Ebbw Vale Metallurgical Society . . . . . C. Leighton
President of the Leeds Metallurgical Society . . . . . J. H. Cairns
President of the Lincolnshire Iron and Steel Institute . . . . . J. D. Joy
President of the Liverpool Metallurgical Society . . . . . R. W. Wilson
Chairman of the London Metallurgical Society . . . . . W. E. Duckworth
President of the Manchester Metallurgical Society . . . . . G. M. Leak
Chairman of the Newport and District Metallurgical Society . . . . . K. Carr
Chairman of the North Wales Metallurgical Society . . . . . I. O. V. Thomas
President of the Sheffield Metallurgical and Engineering Association . . . . . G. W. Giles
Chairman of the South Midlands Metallurgical Association . . . . . B. Arnold
President of the South Wales Metallurgical Association . . . . . B. G. Baldwin
President of the Staffordshire Iron and Steel Institute . . . . . G. R. Morton
President of the Stoke-on-Trent Metallurgical Society . . . . . D. Field
Chairman of the Tyne-Wear Metallurgical Society . . . . . K. H. Jack
President of the West Cumberland Metallurgical Society . . . . . D. R. G. Davies
President of the West of England Metals and Materials Association . . . . . E. Poole
President of the West of Scotland Iron and Steel Institute . . . . . J. A. Kilby

Secretary A. Post, T.D. **Librarian and Head of the Information Department** M. L. Pearl

General Assistant Secretary H. F. Cleere, F.S.A. **Assistant Secretary (Administration)** R. B. Wood

CONTENTS

Volume 206 July—December 1968

An annual author and subject index to the *Journal of The Iron and Steel Institute* (covering all papers and abstracts contained in it) is published separately. It also includes ISI Books and the titles of Institute Bibliographies published during the year. The papers which appear in this bound volume are given below (listed according to first author) and are followed by Institute business, discussions, technical notes, etc. BISRA papers are indicated by their number.

PAPERS

ANDERSON, E. and SPREADBOROUGH, J.: Yielding, twinning and fracture of Armco iron and alloys of iron with silicon, chromium, and manganese, 1223.

BANKS, E. E.: Metallographic features of explosively produced spall fracture in a low-carbon steel, 1022.

BELL, T.: Martensite transformation start temperature in iron–nitrogen alloys, 1017. (BISRA Paper MG/A/85/67.)

BHARGAVA, OM P. and HINES, W. G.: Rapid determination of CaF_2 in fluorspar with EDTA, 1033.

BIRKBECK, G.: Effect of aluminium-killing on the yield and fracture behaviour of a 0·16–0·2C, 0·65–0·75Mn steel, 909.

ČERNOCH, S. and KOŠTIAL, I.: Improving batch reheating furnace efficiency by shortening the soaking period, 814.

CHATURVEDI, M. C., HONEYCOMBE, R. W. K. and WARRINGTON, D. H.: Stacking fault precipitation of NbC in Fe–Mn austenites, 1236.

CHODOROWSKI, J., JURCZAK, K. and LAMPE, J.: Phase analysis of 9–4–2 and 12–4–2 high-speed steels with increased carbon content, 1131.

COTTRELL, C. L. F. and LANGSTONE, P. F.: Practical use of K_{1C} and its variation by steel manufacture and treatment, 1077.

DAFF, T.: Scunthorpe's first furnace, 693.

DELVE, F. D., DUDERSTADT, G. C. and KOWAL, R. F.: Kinetics of carbon and oxygen removal in the DH process at low carbon levels, 1218.

DENNISON, T.: Progress and change in the iron and steel industry, 645.

DISTIN, P. A., HALLETT, G. D. and RICHARDSON, F. D.: Some reactions between drops of iron and flowing gases, 821.

DUHAJ, P. and IVAN, J.: Orientation relationship between χ-phase and austenite, 1014.

DUHAJ, P., IVAN, J. and MAKOVICKÝ, E.: Sigma-phase precipitation in austenitic steels, 1245.

FIELDEN, C. J. and WOOD, B. I.: A dynamic digital simulation of the blast furnace, 650. (BISRA Paper PE/B/26/68.)

FLUX, J. H.: Reheating for hot working in the steel industry, 757.

FLUX, J. H., SMITHSON, D. J. and SMITHSON, R. N.: Simplified dust sampling apparatus for use in iron- and steelworks, 1188.

FRANCIS, J. M., LEE, C. J. and BUDDERY, J. H.: Effects of thermal cycling on the oxidation behaviour of an austenitic steel in CO_2, 921.

GUTT, W.: Crystallization of merwinite from melilite compositions, 840.

HALLETT, M. M. and MORTON, G. R.: Yarranton's blast furnace at Sharpley Pool, Worcestershire, 689.

HELMI, A. and ALEXANDER, J. M.: Geometric factors affecting spread in hot flat rolling of steel, 1110.

HUNTER, W.: Water cooling, 1065.

JENKINS, C. F. and SMITH, G. V.: Effects of interstitial impurities and plastic strain on the aging behaviour of a 35%Ni–15%Cr steel, 1267.

JOHNSON, A.: Blast-furnace process research by the SCICE technique, 671. (BISRA Paper IM/B/20/67.)

KEEN, T. H. and GUY, P. C. F.: The development of 'forward costing' based on 'standard costing' for use with operational planning and control, 800.

KOR, G. J. W. and RICHARDSON, F. D.: Sulphur in lime–alumina mixtures, 700.

LAHIRI, A. K.: Rate of reduction of a dense hematite sphere by hydrogen, 925.

LAHIRI, A. K. and SESHADRI, V.: Kinetics of reaction of porous solid with gas, 1118.

LISTER, R. R.: Investigation into failure mechanisms in blast furnace boshes, 1194.

MASSEY, R. G.: Identity – the why and wherefore, 873.

MAUNDER, P. J. H. and CHARLES, J. A.: Behaviour of non-metallic inclusions in a 0·2% carbon steel ingot during hot rolling, 705.

MAZANEK, E. and JASIEŃSKA, S.: Properties of self-fluxing sinters of basicity 1·0–3·5, 1104.

MORGAN, E. L., BLANK, J. R., SALTER, W. J. M. and PICKERING, F. B.: Formation of non-metallic inclusions during basic electric arc steelmaking, 987.

MORGAN, R. and RALPH, B.: A field-ion microscope study of pearlite, 1138.

MURRAY, T. G. and STAMP, K. E.: The business plan, 660.

NORDBERG, H. and ARONSSON, B.: Solubility of niobium carbide in austenite, 1263.

OATES, G.: Effect of hydrostatic stress on cleavage fracture in a mild steel and a low-carbon manganese steel, 930.

OHNO, R. and ISHIDA, T.: Rate of evaporation of manganese, copper, tin, chromium, and sulphur from molten iron under vacuum, 904.

OLIVER, R. A. and WILD, R.: Gaseous reduction in the blast furnace: use of the modified Linder test, 1070. (BISRA Paper IN/B/62/67.)

PEARL, M. L.: Iron and steel industry profiles, 1151.

PEARSON, T. F.: Manufacture of steel in the oxygen converter with special reference to cleanness, 969.

PERRY, J. and SMITH, D. G.: Annealing and patenting of steel wires in controlled atmospheres, 1181.

PIETIKÄINEN, J.: Effect of plate size, aging, and test temperature on the fracture of martensite in Fe–Ni–Si–C steels, 834.

PRIESTNER, R., EARLEY, C. C. and RENDALL, J. H.: Observations on the behaviour of austenite during the hot working of some low-carbon steels, 1252.

SABATINI, B., WOODCOCK, J. W. and YEOMANS, K. A.: Shape regulation in flat rolling, 1214. (BISRA Paper PE/B/35/68.)

SABATINI, B. and YEOMANS, K. A.: An algebra of strip shape and its application to mill scheduling, 1207. (BISRA Paper PE/B/36/68.)

SARA, E. T.: Market forecasting, 666.

SCOTT, T. A.: Management reporting, 793.

SHAUGHNESSY, R. N.: Wear and life of hot strip mill rolls, 981.

SHOHET, K. N. and BOYCE, M. F.: Static model tests of roll bending methods of crown control, 1099. (BISRA Paper PE/C/22/68.)

SHOHET, K. N. and TOWNSEND, N. A.: Roll bending methods of crown control in 4-high plate mills, 1088. (BISRA Paper PE/C/11/68.)

SHORTLAND, M. G.: Tracking: systems requirements and systems in use, 881.

SPOONER, J. H.: Management accounting, 773.

SUBRAMANIAN, S. V., HAWORTH, C. W. and KIRKWOOD, D. H.: Growth morphology and solute segregation in the solidification of some iron alloys, 1027.

SUBRAMANIAN, S. V., HAWORTH, C. W. and KIRKWOOD, D. H.: Development of interdendritic segregation in an iron–arsenic alloy, 1124.

TOWNSEND, N. A.: Physical methods of identification marking, 886. (BISRA Paper PE/C/39/67.)

WILLIAMSON, J. and BENHAM, P. P.: Brittle fracture stress and temperature gradient tests on two ship steels, 716.

WILLIAMSON, J., TIPPLE, A. J. and ROGERS, P. S.: Influence of iron oxides on the kinetics of crystal growth in $CaO–MgO–Al_2O_3–SiO_2$ glasses, 898.

WILSON, D. V. and OGRAM, G. R.: Directionality of yield point in strain-aged steels, 911.

WISTREICH, J. G.: Control of strip shape during hot rolling, 1203. (BISRA Paper PE/B/34/68.)

THE IRON AND STEEL INSTITUTE

Annual General Meeting 1968: Formal business, 768.

DISCUSSIONS

Discussion on 'The business plan', 664.

Discussion on 'Market forecasting', 669.

Discussion on 'Management accounting', 789.

Discussion on 'Management reporting' and on 'The development of "forward costing" based on "standard costing" for use with operational planning and control', 810.

Discussion on 'Identity – the why and wherefore', 877.

Discussion on tracking and identification systems, 892.

Discussion on the problems associated with flat rolled products, 894.

Discussion on 'The tandem furnace process at Vanderbijlpark', 1002.

Discussion on problems associated with heavy sections, bars, and billets, 1007.

TECHNICAL NOTES

ALBUTT, K. J. and GARBER, S.: Iron–nitrogen martensitic sheet, 1037.

BELL, D. R.: Hafnium in carbon–manganese steel: some preliminary observations, 1148.

CHATURVEDI, M. C., HONEYCOMBE, R. W. K. and WARRINGTON, D. H.: Dislocation precipitation of NbC in iron–manganese austenites, 1146.

LINDLEY, T. C. and OATES, G.: The cracking of grain boundary carbide films in a 1·4% manganese steel, 935.

MARTIN, J. W. and BENSON, R.: Influence of insonation on the case-hardening of steel, 936.

MAUNDER, P. J. H. and CHARLES, J. A.: Nucleation of metallic and sulphide phases on high melting point oxide precipitates within silicate inclusions, 1039.

RAWLINGS, R. D. and NEWEY, C. W. A.: Study of the iron–molybdenum system by means of diffusion couples, 723.

YAMAGUCHI, S.: The magnetization axis of permalloy, 724.

CORRESPONDENCE ON PAPERS

ARNELL, R. D.: Correspondence on the paper: 'Determination of retained austenite in steel by X-ray diffraction', 1035.

BONISZEWSKI, T.: Correspondence on the paper: 'Interaction of hydrogen with voids in steel', 813.

WORLEY, E. M.: Correspondence on the paper: 'Future pattern of the tinplate industry', 1036.

REPORTS OF CONFERENCES AND MEETINGS

Annual General Meeting 1968. Report by G. P. SANDERSON of Conference on 'High-temperature oxidation of iron and steel', 1149.

NEWS

725, 842, 937, 1041, 1155, 1273.

TRANSLATIONS

727, 843, 939, 1043, 1158, 1274.

ABSTRACTS

729, 845, 941, 1045, 1161, 1277.